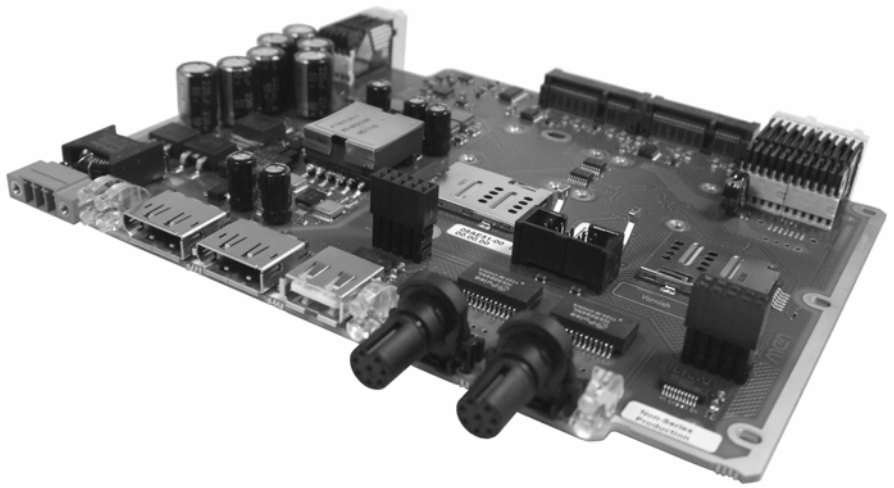
Embedded Solutions

AE51 – Graphics and I/O Interface for Display Computers



Configuration example

User Manual

mikro elektronik
gmbh · nürnberg

AE51 – Graphics and I/O Interface for Display Computers

The AE51 is a combined graphics and I/O interface board for MEN's display computer electronics like the SC24 SBC and possible subsequent models.

Three rugged AirMax VS® connectors transport the various I/O signals from the SBC board to the AE51, where they are made available on standard connectors like USB, 9-pin D-Sub (serial I/O and HD audio, both optional), 8-pin M12 (Gigabit Ethernet), DisplayPort® and SATA. Touch functionality can be realized via the USB port. Note that the AE51 is just one suggested interface board variant for SBCs like the SC24 and as such it does not necessarily cover all possible interfaces of the connected SBC board. For example, only two independent DisplayPort® interfaces (B and C, with their individual AUX and USB channel respectively) are made available on standard DP connectors, whereas an SC24 offers two additional DisplayPort® interfaces (identical to the former two regarding image content).

The AE51 serves as a 2x PCI Express® Mini Card carrier for the connected SBC board. Two SIM card slots are available. By default, one is used for each of the two PCI Express® Mini Cards, but the first PCI Express® Mini Card can also switch between the two SIM cards as an option. The necessary antenna connectors can be led to a front panel.

As an option, a SATA interface from the SBC board can be made available along with a 4-pin power connector for the drive, however the AE51 is not designed as a SATA HDD/SSD carrier board – the drive must be mounted independently.

The board also serves as a 30W 24 VDC nom. (9 to 36 V) class S2 wide-range power supply for the connected SBC board. If the connected display panels require more power, an external PSU can be connected via an optional power bypass connector on the AE51 to supply the necessary 12 VDC voltage for the system.

Technical Data

Board-to-board connection

- 3 AirMax VS® connectors
  - To SBC board's graphics and I/O connectors P1/P2/P4

I/O

- 2 DisplayPort® interfaces
  - DisplayPort® 1 with AUX channel and hot plug detection
  - DisplayPort® 2 with USB channel
- HD audio
  - HD audio codec (Realtek ALC268)
  - Audio stereo in
  - Audio stereo out
  - SPDIF out
  - Via 10-pin onboard connector
- 2 Gigabit Ethernet
  - Via M12 connectors
- 1 USB 2.0
  - Via Type A connector
- 2 SA-Adapter™ slots for serial I/O
  - 1 UART or IBIS, GPS
  - 1 UART or CAN bus
- 8 status LEDs
  - 4 for Ethernet link and activity status
  - 2 for general board status
  - 2 for power supply status

2 PCI Express® Mini Card slots

- For functions like WIFI, WIMAX, GSM/GPRS, UMTS
- 2 SIM card slots
- PCI Express® and USB interface

Accelerometer / Magnetometer

- 3 acceleration channels
  - 2 independent programmable interrupt generators for free-fall and motion detection
- 3 magnetic field channels
  - ±1.3 to ±8,1 gauss magnetic field full-scale

Miscellaneous

- Gold Cap to buffer real-time clock on connected SBC board

Electrical Specifications

- Isolation voltage:
  - Ethernet ports: 1,500 VDC
  - DC/DC: 1,500 VDC
- Supply voltage:
  - 24 VDC nom. (9 to 36 V)
  - EN 50155 power interruption class S2
- Power output: 12 VDC nom.
- Power consumption: Up to 30 W

Mechanical Specifications

- Dimensions: approx. 170 mm x 132 mm x 30 mm
- Weight: approx. 100 g

Environmental Specifications

- Temperature range (operation):
  - 0..+60°C up to -40..+85°C (screened)
  - Fanless operation
- Temperature range (storage): -40..+85°C
- Relative humidity (operation): max. 95% non-condensing
- Relative humidity (storage): max. 95% non-condensing
- Altitude: -300 m to +3,000 m
- Shock: 50 m/s², 30 ms
- Vibration (function): 1 m/s², 5 Hz – 150 Hz
- Vibration (lifetime): 7.9 m/s², 5 Hz – 150 Hz
- Conformal coating on request

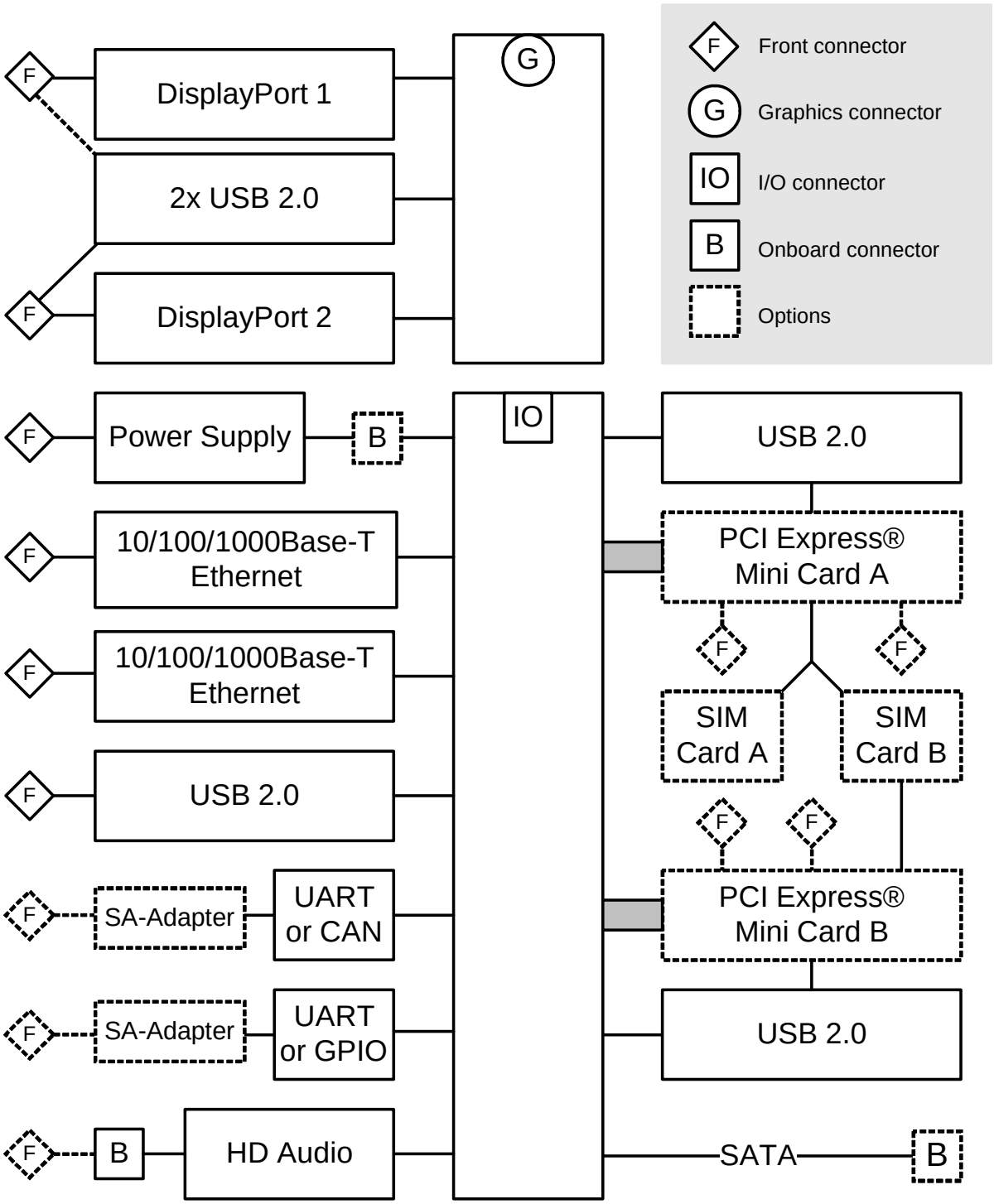
MTBF

- tbd. @ 40°C according to IEC/TR 62380 (RDF 2000)

EMC

- Conforming to EN 55022 (radio disturbance), IEC 61000-4-2 (ESD) and IEC 61000-4-4 (burst)
- Prepared for certification according to e1 requirements of the German Federal Motor Transport Authority

Block Diagram



Configuration Options

I/O

- DisplayPort® 1 with USB channel instead of AUX channel
- HD audio
  - Ribbon cable adapter to 9-pin D-Sub front I/O connector
- Antenna connectors
  - For functions like WIFI, WIMAX, GSM/GPRS, UMTS in combination with PCI Express® Mini Card(s)
  - Reverse SMA connector

Mass Storage

- Serial ATA (SATA)
  - One port for external hard-disk/solid-state drive

Electrical Specifications

- Input voltage 36 VDC nom. via front connector (alternate internal PSU)
- Input voltage 12 VDC via optional onboard power bypass connector

As the product concept is very flexible, there are many other configuration possibilities. Please contact our sales team if you do not find your required function in the options.

For available standard configurations see online data sheet.

Product Safety

Electrostatic Discharge (ESD)

Computer boards and components contain electrostatic sensitive devices. Electrostatic discharge (ESD) can damage components. To protect the board and other components against damage from static electricity, you should follow some precautions whenever you work on your computer.

- Power down and unplug your computer system when working on the inside.
- Hold components by the edges and try not to touch the IC chips, leads, or circuitry.
- Use a grounded wrist strap before handling computer components.
- Place components on a grounded antistatic pad or on the bag that came with the component whenever the components are separated from the system.
- Store the board only in its original ESD-protected packaging. Retain the original packaging in case you need to return the board to MEN for repair.

About this Document

This user manual describes the hardware functions of the board, connection of peripheral devices and integration into a system. It also provides additional information for special applications and configurations of the board.

The manual does not include detailed information on individual components (data sheets etc.). A list of literature is given in the appendix.

History

Issue	Comments	Date
E1	First issue	2011-09-15
E2	Added cover photo, product weight, DC/DC isolation voltage Standard model comes without a front panel, some drawings still depict a possible front panel for clarity Configuration options: Added SATA, power bypass connector, USB instead of AUX for DisplayPort 1 HD audio is a standard feature (via onboard connector - D-Sub adapter for front panel optional) Updated block diagram with the above changes Clarified position and individual functionality of the two optional serial interfaces Added pinout for HD audio onboard connector Changed order of DisplayPort pinout mnemonics table Added product page links for temperature sensor / EEPROM and accelerometer / magnetometer Minor changes, cosmetics	2011-11-03
E3	Removed pin assignment of board-to-board connector (to be included in manuals for SBC boards), reworked phrasing regarding DisplayPort connector pin assignment and USB via AUX option on SC24. Manual now less focused on a specific SBC board. Reworked PCI Express Mini Card connector pin assignment table (signal directions now given from SBC perspective)	2011-12-09
E4	Added Gold Cap to technical data	2011-12-23

Conventions

This sign marks important notes or warnings concerning proper functionality of the product described in this document. You should read them in any case.

italics	Folder, file and function names are printed in *italics*.
bold	**Bold** type is used for emphasis.
`monospace`	A `monospaced` font type is used for hexadecimal numbers, listings, C function descriptions or wherever appropriate. Hexadecimal numbers are preceded by "0x".
hyperlink	Hyperlinks are printed in blue color.
	The globe will show you where hyperlinks lead directly to the Internet, so you can look for the latest information online.
IRQ# /IRQ	Signal names followed by "#" or preceded by a slash ("/") indicate that this signal is either active low or that it becomes active at a falling edge.
in/out	Signal directions in signal mnemonics tables generally refer to the corresponding board or component, "in" meaning "to the board or component", "out" meaning "coming from it".
	Vertical lines on the outer margin signal technical changes to the previous issue of the document.

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1 Getting Started

This chapter gives an overview of the board and some hints for first installation in a system.

1.1 Map of the Board

Figure 1. *Map of the board – top view*

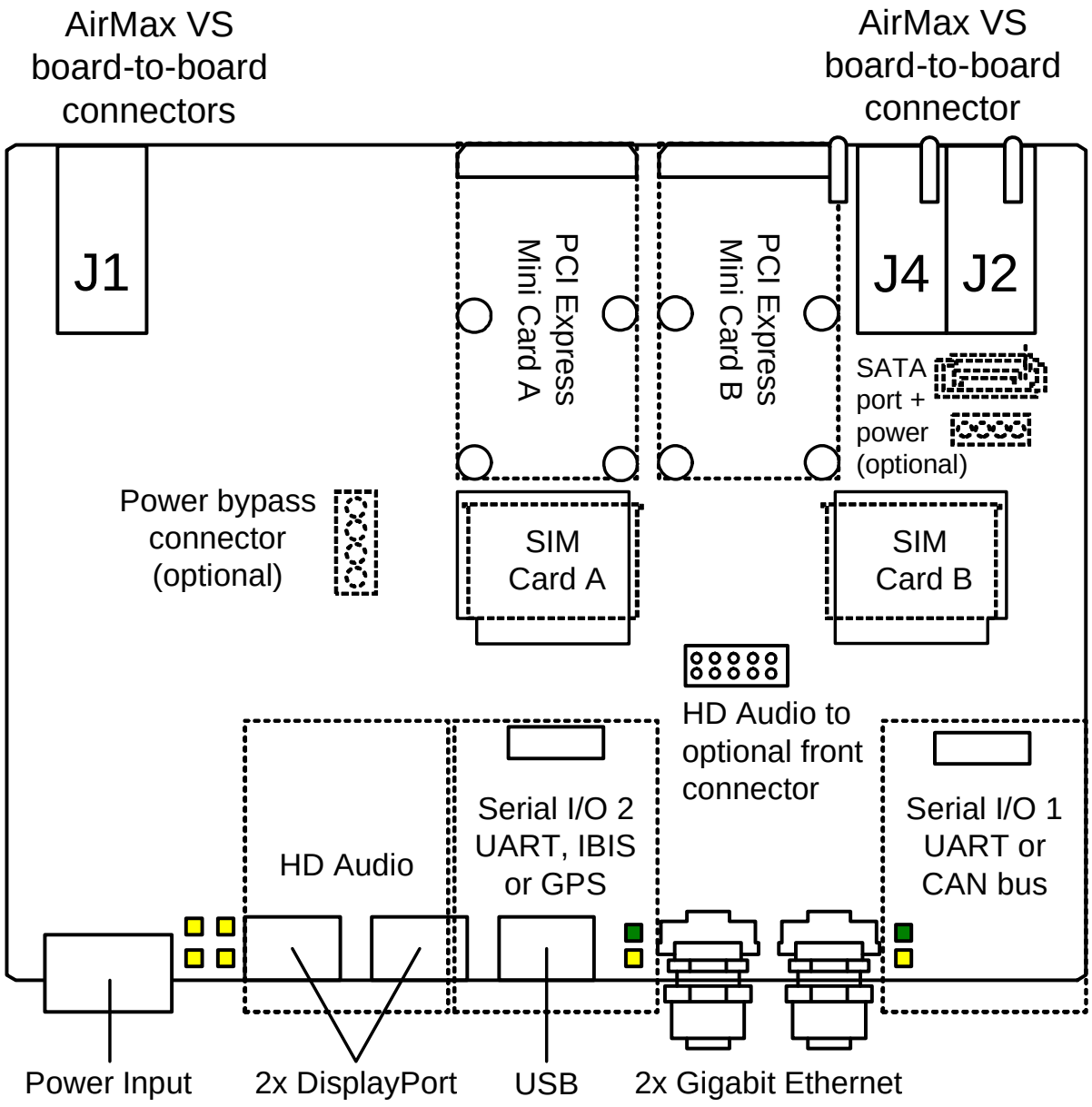
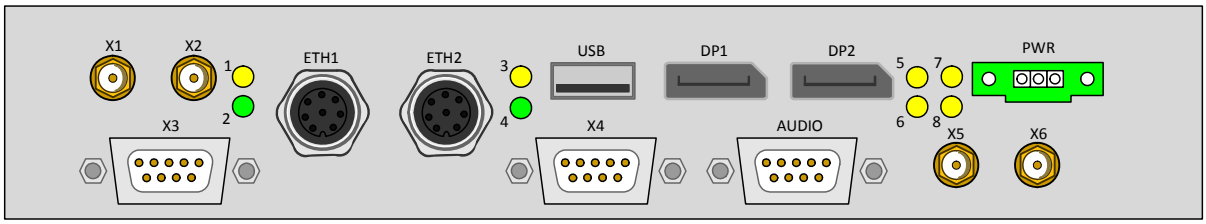


Figure 2. *Map of the board – front connectors shown behind possible front panel*



All optional connectors shown.

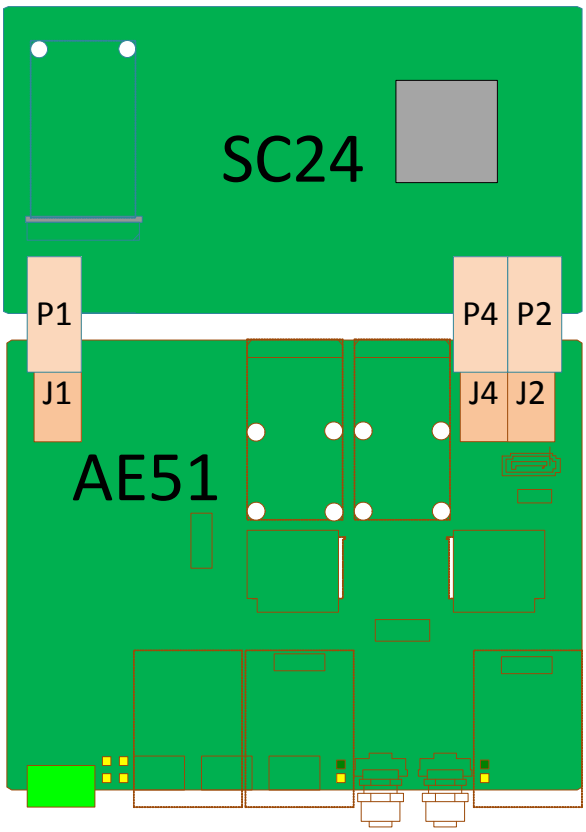
Top level, left to right: PCI Express Mini Card B SMA antenna connectors, Ethernet port 1 status LEDs, Ethernet port 1, Ethernet port 2, Ethernet port 2 status LEDs, USB, DisplayPort 1, DisplayPort 2, general status LEDs, power input

Bottom level, left to right: Serial interface 1 (UART or CAN bus), serial interface 2 (UART or IBIS or GPS), HD audio, PCI Express Mini Card A SMA antenna connectors.

1.2 Installing the Adapter in a System

The AE51 was designed as a joint graphics and I/O connector board for MEN's display computer electronics like the SC24. The connection to the SBC board is realized via two pairs of AirMax VS connectors.

Figure 3. *Connecting an AE51 and an SBC board via the AirMax VS connectors*



2 Interface to CPU Board

The AE51 is connected to the SBC board via three AirMax VS connectors, serving as a joint I/O and graphics interface board.

Connector type:

• 72-pin AirMax VS press-fit receptacle, 6 rows, right-angle (FCI 10114633-101LF)

Mating connector:

• 72-pin AirMax VS press-fit 2 wall signal header, 6 rows, right angle header (FCI 10052824-101LF)

The pin assignment matches the compatible SBC boards, e.g., the SC24, and is not repeated here. Please refer to the SBC board's manual for a complete list of signals.

3 Onboard Connectors

3.1 Power Supply Connector

The AE51 is supplied with 24 VDC nom. (9 to 36 V) via a 3-pin COMBICON connector. An input voltage of 36 VDC nom. can be realized as an option.

Connector type:

- 3-pin COMBICON receptacle (Phoenix Contact 1843800 MC 1,5/ 3-GF-3,5)

Mating connector:

- 3-pin COMBICON plug, e.g., Phoenix Contact 1863314 MCVR 1,5/ 3-STF-3,5

Table 1. *Pin assignment of PSU connector*

	1	POWERCON_IN	Power input
	2	POWERCON_GND	Power input ground
	3	IGNITIONCON	Ignition

3.2 Power Bypass Connector (optional)

If the power consumption of the system should exceed the 30 W limit of the AE51's integrated power supply, e.g., when the system is also used to power a large display panel, the board's internal DC/DC converter can be bypassed. For this purpose, the board can be equipped with the optional power bypass connector to enable the connection of a more powerful external PSU, supplying the connected SBC board with the necessary input voltage of 12 VDC.

Connector type:

- 4-pin COMBICON receptacle (Phoenix Contact 1755752 MSTBVA 2,5/ 4-G-5,08)

Mating connector:

- 4-pin COMBICON plug, e.g., Phoenix Contact 1786420 IC 2,5/ 4-G-5,08

Table 2. *Pin assignment of optional power bypass connector*

	1	VCC_FLYBACK	Power to additional DC/DC converter output
	2	IGND	Isolated power input ground
	3	12V_FLYBACK_OUT	12V from external DC/DC converter
	4	GND	GND

3.3 Mass Storage

3.3.1 Serial ATA (SATA) (optional)

As an option, the AE51 can provide one serial ATA (SATA) interface controlled by the connected CPU board. It is available via a standard 7-pin SATA connector. You can connect a hard-disk or solid state drive. Please note that the AE51 is not designed as a carrier board for such drives - any drives have to be installed externally. Power for the drive is supplied via a 2.5mm 4-pin header. Please refer to Figure 1, Map of the board – top view on page 13 for the connectors' exact positions.

The SATA interfaces support transfer rates up to 300 MB/s.

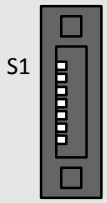
Connector type:

- 7- pin SATA receptacle, 1.27mm pitch

Mating connector:

- 7- pin SATA plug, 1.27mm pitch

Table 3. *Pin assignment of optional SATA connector*



S1	GND	Digital ground
S2	SATA_TX+	SATA transmit positive
S3	SATA_TX-	SATA transmit negative
S4	GND	Digital ground
S5	SATA_RX-	SATA receive positive
S6	SATA_RX+	SATA receive negative
S7	GND	Digital ground

Connector type:

- 4-pin header for IDE drive power supply (2.5 mm)

Mating connector:

- 4-pin IDE drive power plug (2.5 mm)

Table 4. *Pin assignment of optional HDD/SSD power supply connector*

S1	+12V	+12V power supply
S2	GND12V	Digital ground
S3	GND5V	Digital ground
S4	+5V	+5V power supply

3.4 DisplayPort Interfaces

Two of the DisplayPort interfaces available on the SBC board (DisplayPort B on the DP1 connector and DisplayPort C on DP2) can be accessed at the front panel.

Note: Only DisplayPort B (on the DP1 connector) is a fully featured DisplayPort interface and offers AUX channel support and hot plug detection. With the DisplayPort C interface (on the DP2 connector), the AUX lines are used for a USB connection. This makes it impossible for the SBC board to exchange device management and control data with the display panel connected to this interface, but in turn it enables features like an USB-driven touch interface via the DisplayPort connector. USB instead of AUX can also be made available on the DP1 connector as an option.

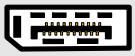
Connector type:

- 20-pin DisplayPort receptacle

Mating connector:

- 20-pin DisplayPort plug

Table 5. *Pin assignment of 20-pin DisplayPort connector*



	20	POWER	19	RETURN PWR
	18	DPx_HOTPLUG	17	DPx_AUX- (option: DPx_USB_n)
	16	GND	15	DPx_AUX+ (option: DPx_USB_p)
	14	CONFIG2	13	CONFIG1
	12	LANE_3-	11	GND
	10	LANE_3+	9	LANE_2-
	8	GND	7	LANE_2+
	6	LANE_1-	5	GND
	4	LANE_1+	3	LANE_0-
	2	GND	1	LANE_0+

Table 6. *Signal mnemonics of 20-pin DisplayPort connector*

Signal	Direction	Function
GND	-	Ground
POWER	out	Power for connector (3.3 V, 500 mA)
RETURN PWR	-	Return for Power
DPx_HOTPLUG	in	Hot Plug Detect
DPx_AUX-, DPx_AUX+	in/out	Bi-directional half-duplex auxiliary channels for device management and device control Note: As an option, these lines can be used for a USB interface, as realized for DisplayPort C on the SC24 SBC board.

Signal	Direction	Function
DPx_USB_n/p	in/out	USB negative/positive
CONFIG1, CONFIG2	-	Connected to Ground
LANE_[3..0]+,LANE_[3..0]-	out	Main Link data lanes

3.5 USB Interface

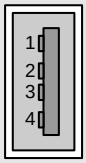
Connector type:

- 4-pin USB Type A receptacle according to Universal Serial Bus Specification Revision 1.0

Mating connector:

- 4-pin USB Type A plug according to Universal Serial Bus Specification Revision 1.0

Table 7. *Pin assignment of USB front-panel connectors*



1	+5V	+5 V power supply
2	USB_D-	USB negative
3	USB_D+	USB positive
4	GND	Digital ground

3.6 Ethernet Interface

For detailed information regarding the Ethernet controllers, MAC address etc please consult the SBC board manual. This manual only deals with the physical Ethernet connectors on the AE51.

Connector type:

- 8-pin M12 receptacle, female, A-coded 90° (Phoenix Contact 1436974 SACC-DSIV-FS-8CON-L90 SCO)

Mating connector:

- 8-pin M12 plug, male, A-coded

Table 8. *Pin assignment of Ethernet front-panel connectors*

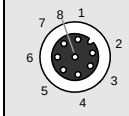
		1000Base-T	10/100Base-T
	1	BI_DC-	
	2	BI_DD+	
	3	BI_DD-	
	4	BI_DA-	TX-
	5	BI_DB+	RX+
	6	BI_DA+	TX+
	7	BI_DC+	-
	8	BI_DB-	RX-

Table 9. *Signal mnemonics of Ethernet front-panel connectors*

Signal	Direction	Function
BI_Dx+/-	in/out	Differential pairs of data lines for 1000Base-T
RX+/-	in	Differential pair of receive data lines for 10/100Base-T
TX+/-	out	Differential pair of transmit data lines for 10/100Base-T

3.6.1 Ethernet Status LEDs

The AE51 provides a total of four Ethernet status LEDs, two for each Ethernet channel. They signal the link and activity status (different LED behavior can be realized on demand).

Table 10. *Ethernet status LED*

LED	Description	LED	Description
1	Port 1 activity	**3**	Port 2 activity
2	Port 1 link	**4**	Port 2 link

3.7 General Status LEDs

In addition to the four Ethernet status LEDs, the AE51 provides four general status LEDs. Two of them signal whether input power is applied and whether the output power to the SBC board as generated by the AE51's onboard DC/DC converter is within valid range.

The status LED is connected to the system's board management controller. Please refer to the manual for the connected SBC board for information on its behaviour. The user LED A is connected to an SGPIO line and can be used freely depending on an application's requirements.

Figure 4. *General status LEDs on a possible front panel (shown partially)*

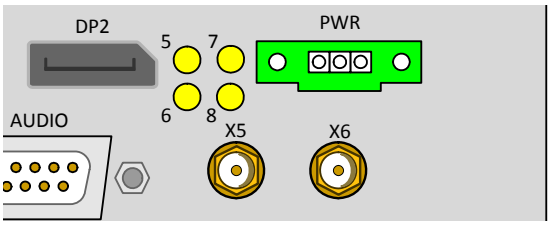


Table 11. *General status LEDs (as depicted above)*

LED	Description	LED	Description
5	Output power 12V OK	**7**	Status
6	Input power applied	**8**	User LED A

3.8 HD Audio

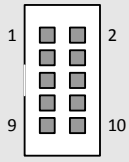
The AE51 supports a high definition audio interface implemented via the Realtek ALC268 codec. It is available on a 10-pin onboard connector and can be led to a standard 9-pin D-Sub front connector via an optional ribbon cable adapter.

Connector types:

10-pin low profile header with lock, 2.54 mm pitch, for ribbon-cable connection

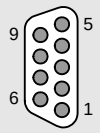
Mating connector:
10-pin IDC receptacles, e.g., Elco Series 8290 IDC socket

Table 12. *Pin assignment of the HD audio onboard connector*



1	AUDIO_OUT_L+	2	AUDIO_GND
3	AUDIO_OUT_R-	4	AUDIO_IN_L
5	AUDIO_SPDIF	6	AUDIO_OUT_L-
7	AUDIO_OUT_R+	8	AUDIO_GND
9	AUDIO_IN_R	10	not connected

Table 13. *Pin assignment of the optional HD audio D-Sub front connector*



9	AUDIO_IN_R	5	AUDIO_SPDIF
8	AUDIO_GND	4	AUDIO_IN_L
7	AUDIO_OUT_R+	3	AUDIO_OUT_R-
6	AUDIO_OUT_L-	2	AUDIO_GND
		1	AUDIO_OUT_L+

Table 14. *Signal mnemonics of the HD audio interface*

Signal	Direction	Description
AUDIO_OUT_L±/R±	out	Line out, left and right, differential signal pairs
AUDIO_IN_L/R	in	Line in, left and right
AUDIO_GND	-	Analog ground
AUDIO_SPDIF	out	S/PDIF output

3.9 Serial Interfaces via SA-Adapter (optional)

As an option, the board offers the possibility to provide two serial interfaces at the connector PCB using a MEN standard SA-Adapter. This way, a serial interface can be used which can be flexibly configured as needed. SA-Adapter slot 1 (available at the X3 front connector) can be used for UART or CAN bus while slot 2 (X4) can be used for UART, IBIS or GPS functionality. Please consult the respective SA-Adapter user manual for installation instructions.

See MEN's website for a list of SA-Adapters which can be used on the AE51.

Please contact MEN's sales team for information about possible configurations and special board versions.

3.10 PCI Express Mini Card Interface

The AE51 supports the PCI Express Mini Card standard. As an option, it can also be equipped with PCI Express Mini Card slots compatible with half-size modules.

PCI Express Mini Cards are small form factor PCI Express cards. The main differences between an ExpressCard and a PCI Express Mini Card is a smaller form factor optimized for mobile computing platforms and a card-system Interconnection optimized for communication applications. PCI Express Mini Cards also use smaller connectors than standard ExpressCards.

The cards use either a single PCI Express lane (x1) or a USB connection; the AE51 supports both. It is equipped with two 52-pin standard PCI Express Mini Card connectors. The following standard signals are supported (signal directions according to PCI Express Mini Card standard):

Table 15. *Pin assignment of 52-pin PCI Express Mini Card connector*

Pin	Signal	Pin	Signal
51	Reserved	52	+3.3Vaux
49	Reserved	50	GND
47	Reserved	48	+1.5V
45	Reserved	46	LED_WPAN#
43	GND	44	LED_WLAN#
41	+3.3Vaux	42	LED_WWAN#
39	+3.3Vaux	40	GND
37	GND	38	USB_D+
35	GND	36	USB_D-
33	PETp0	34	GND
31	PETn0	32	SMB_DATA
29	GND	30	SMB_CLK
27	GND	28	+1.5V
25	PERp0	26	GND
23	PERn0	24	+3.3Vaux
21	GND	22	PERST#
19	Reserved	20	W_DISABLE#
17	Reserved	18	GND
Mechanical Key			
15	GND	16	UIM_VPP
13	REFCLK+	14	UIM_RST
11	REFCLK-	12	UIM_CLK
9	GND	10	UIM_DATA
7	CLKREQ#	8	UIM_PWR
5	Reserved	6	1.5V

Pin	Signal	Pin	Signal
3	Reserved	4	GND
1	WAKE#	2	+3.3Vaux

Table 16. *Signal mnemonics of 52-pin PCI Express Mini Card connector*

	Signal	Direction	Function
Power	GND	-	Ground
	+3.3Vaux	out	3.3V source
	1.5V	out	1.5V source
SIM card	UIM_PWR	in	SIM card power
	UIM_DATA	in/out	SIM card data
	UIM_CLK	in	SIM card clock
	UIM_RST	in	SIM card reset
	UIM_VPP	in	not connected
PCI Express	REFCLK-/REF-CLK+	out	PCI Express differential reference clock
	PERn0/PERp0	in	PCI Express receive signals
	PETn0/PETp0	out	PCI Express transmit signals
Auxiliary Signals	CLKREQ#	in	Clock request
	PERST#	out	Reset for the Mini Card
	W_DISABLE#	out	Wireless disable
	WAKE#	in	Wake signal
	SMB_CLK	out	System management bus clock
	SMB_DATA	in/out	System management bus data
USB	USB_D-	in/out	USB line
	USB_D+	in/out	USB line
Communi-cations - specific signals	LED_WWAN#	in	not connected
	LED_WLAN#	in	not connected
	LED_WPAN#	in	not connected

Please refer to the PCI Express Mini Card Specification for further details. See Chapter 5.1 Literature and Web Resources on page 28.

3.10.1 SIM Card Slots

The AE51 offers two SIM card slots for the two PCI Express Mini Card slots. The default setting has Mini Card A connected to SIM card A and Mini Card B to SIM card B. However, both SIM card slots can be connected to PCI Express Mini Card A if needed. The necessary switching is performed by software via the SIMA_SW and SIMB_SW lines.

Figure 5. *SIM card switching option*

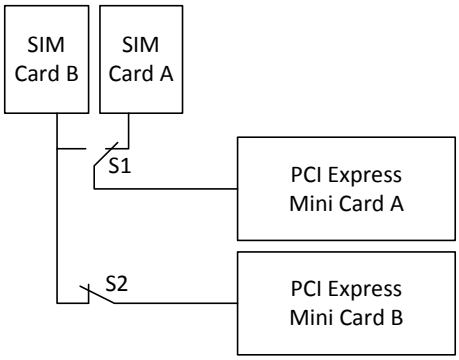


Table 17. *SIM card switching option*

SIMA_SW	SIMB_SW	PCI Express Mini Card A connected to	PCI Express Mini Card B connected to
0	0	SIM card A	SIM card B
0	1	SIM card A	-
1	0	-	SIM card B
1	1	SIM card B	-

4 Organization of the Board

4.1 SMBus Devices

The AE51 adds three additional SMBus devices to the system it is connected to.

Table 18. *SMBus devices*

I²C Bus	Address	Function
0	0x30 (write) 0x31 (read)	LSM303DLH accelerometer
0	0x3C (write) 0x3D (read)	LSM303DLH magnetometer
1	0xAC	STTS424E02 temperature sensor and production data EEPROM

5 Appendix

5.1 Literature and Web Resources

- AE51 data sheet with up-to-date information and documentation:
  www.men.de/products/08AE51-.html

5.1.1 PCI Express Mini Card

- PCI Express Mini Card Electromechanical Specification
  Revision 1.2; October 26, 2007
  PCI Special Interest Group
  www.pcisig.com

5.1.2 Accelerometer / Magnetometer STTS424E02

- Manufacturer's product page for STTS424E02 – Memory module temperature sensor with a 2 Kb SPD EEPROM
  STMicroelectronics
  http://www.st.com/internet/analog/product/250145.jsp

5.1.3 Temperature Sensor / EEPROM LSM303DLH

- Manufacturer's product page for LSM303DLH
  STMicroelectronics
  http://www.st.com/internet/analog/product/147880.jsp

5.2 Finding out the Product's Article Number, Revision and Serial Number

MEN user documentation may describe several different models and/or design revisions of the AE51. You can find information on the article number, the design revision and the serial number on two labels attached to the board.

- **Article number:** Gives the product's family and model. This is also MEN's ordering number. To be complete it must have 9 characters.
- **Revision number:** Gives the design revision of the product.
- **Serial number:** Unique identification assigned during production.

If you need support, you should communicate these numbers to MEN.

Figure 6. *Labels giving the product's article number, revision and serial number*